Shell structure of three littoral species of testate amoebae from the Black Sea (Rhizopodea: Protozoa)

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Introduction

Ultrastructural studies have been reported on both the shell and cytoplasm of testate amoebae from freshwater, moss and soil habitats. Since the first reports of Thomas (1958) and Thomas & Hovasse (1962) on the shell of the genus *Trinema,* several reports have dealt with these structures in other genera, for example *Euglypha* (Mercier *et al.,* 1964; Hedley & Ogden, 1973; Hedley *et al.,* 1974); *Arcella* (Camber *et al.,* 1963; Netzel, 1975; Moraczewski, 1971); *Centropyxis* (Netzel, 1976*a*; Hedley *et al.,* 1976); *Difflugia* (Netzel, 1976*b*; Ogden, 1979) and *Cryptodifflugia* (Hedley *et al.,* 1977). The diversity and complexity of the shell for most of the common freshwater species has been illustrated in the recent publication of an Atlas of Freshwater Testate Amoebae by Ogden & Hedley (1980).

The present work is a contribution to the ultrastructure of the shell of three species of testate amoebae which are found specifically amongst sand of the supralittoral region bordering marine waters.

Materials and Methods

Individual specimens were selected from samples collected from the shores of the Black Sea, Bulgaria during 1977. The animals were fixed in 3% glutaraldehyde in 0·1M cacodylic acid buffer and post-fixed in 1% osmium tetroxide, after fixation for about 10 minutes they were washed several times in distilled water. Each shell was manipulated using a single-hair brush onto small drops of Araldite arranged on an otherwise clean cover slip. The prepared cover slips were mounted onto standard Stereoscan stubs with Araldite, prior to coating evenly with a conducting layer of gold. The stubs were examined on a Stereoscan Mk II operating at 10kV and the results recorded on Ilford HP4 film.

Results

Pomoriella valkanovi Golemansky, 1970

This species is found in underground water littorals on sandy beaches of the Black Sea, where the salinity varies between 15–17·2‰. The shell is colourless or transparent. In outline it is pyriform with anterior region curved, and in transverse section it is circular (Figs 1 and 3). The aperture is circular or oval and bordered by organic cement (Fig. 4). The surface is covered with shell plates that abut against each other, without overlapping, and are joined by an abundance of organic cement (Fig. 2). The shell plates in the aboral region are long, oval, about 9–10μm in length and 6–7μm in width, and in the apertural region they are smaller, about 4–5μm long and 1–2μm in width. Unfortunately the specimens have bacteria and

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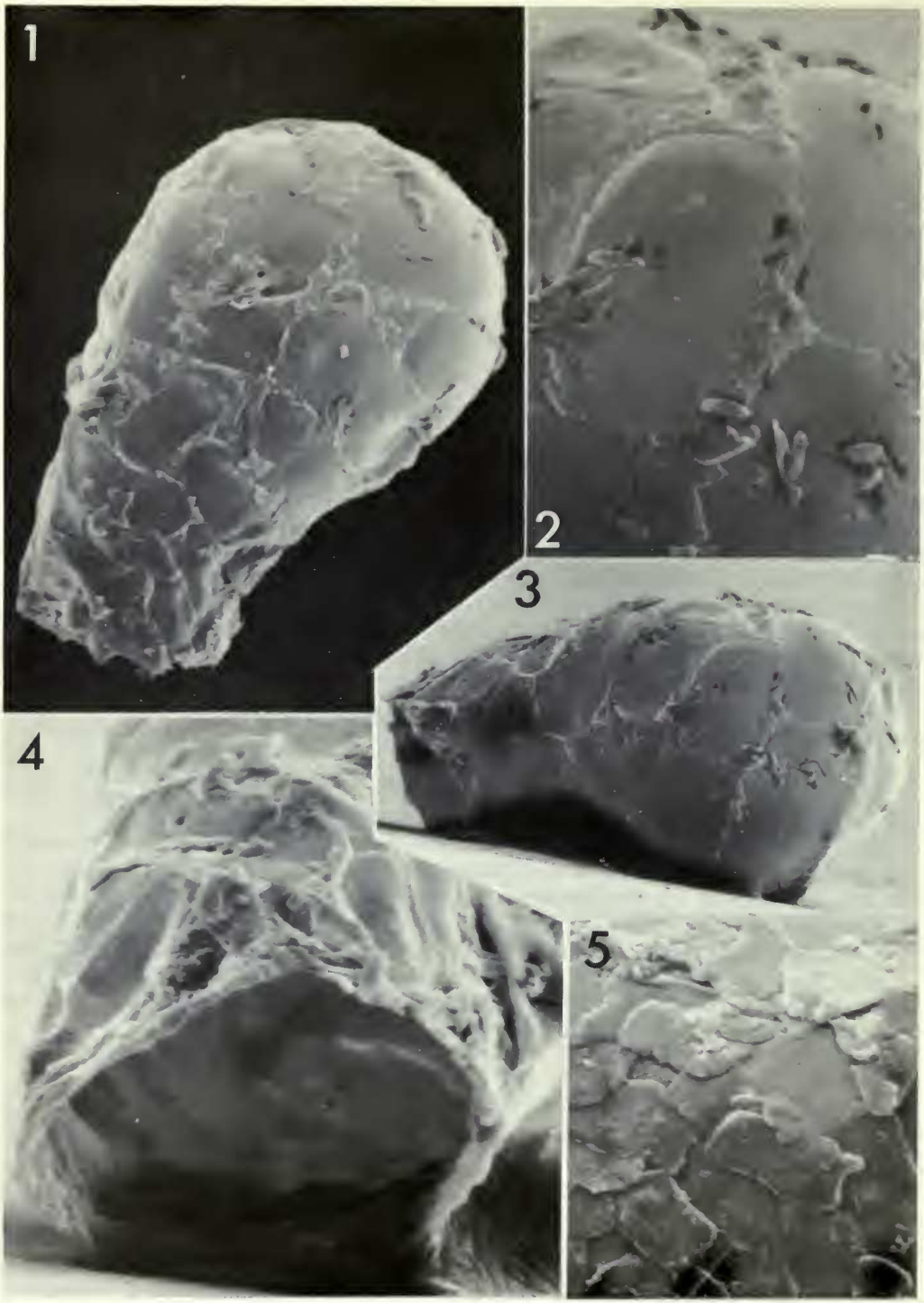
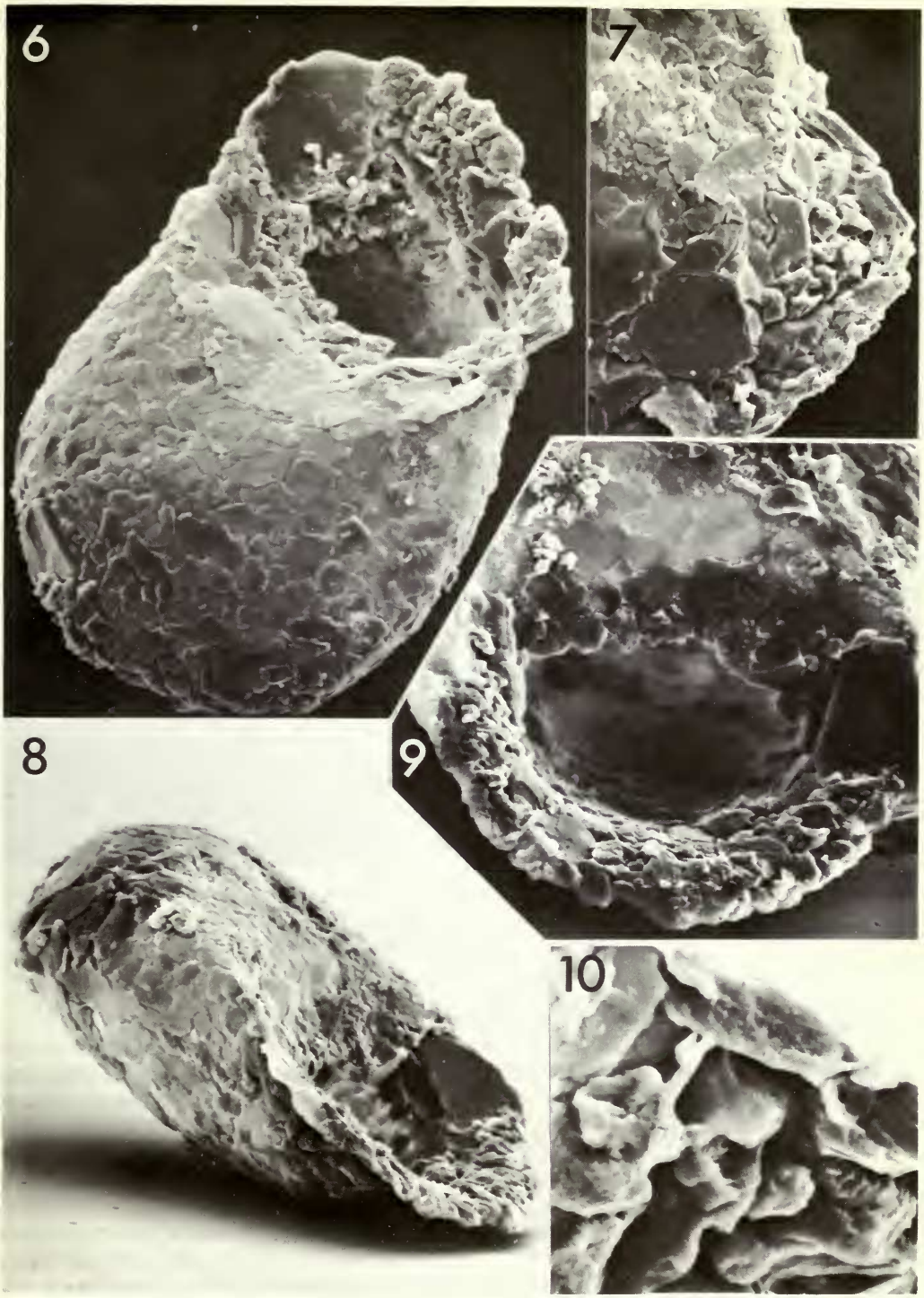


Figs 1–4 *Pomoriella valkanovi* Fig. 1. Lateral view × 2300 Fig. 2. Portion of shell surface, note the organic cement and adhering debris bordering the shell plates × 4800 Fig. 3. View to illustrate the slight curvature of the shell near the aperture × 1900 Fig. 4. Apertural view × 4900.
Fig. 5 Apertural surface of shell of *Centropyxiella arenaria,* to show the arrangement of flat particles × 3600.



Figs 6–10 *Centropyxiella arenaria* Fig. 6. Lateral view, note that most of the shell surface is smooth × 1350 Fig. 7. Aboral view of apertural disc-like extension to show the rough surface × 1400 Fig. 8. Latero-apertural view to illustrate the apertural extension × 1600 Fig. 9. Apertural view × 1950 Fig. 10. Detail of irregular particles forming the apertural extension × 4300.

debris adhering to portions of the shell surface, which obscured some detail. The two specimens examined measured 39; 45μm in length, 24; 21μm in diameter and the diameter of the aperture 13·5; 10·3μm respectively.

In the original description Golemansky (1970) described the shell plates as being rectangular, square or polygonal, sometimes rounded at the corners. It would seem, from the present observations, that the shell plates are usually rounded at the corners, but in all other respects agree with the earlier description.

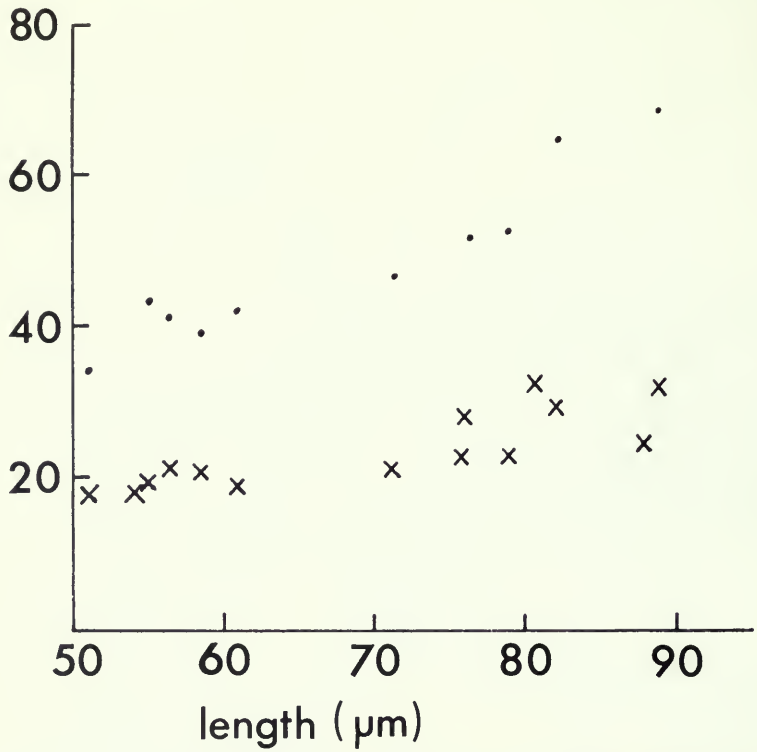


Fig. 11 Measurements of breadth (points) and diameter of aperture (crosses), for individual specimens of *Centropyxiella arenaria*, plotted against the shell length.

Centropyxiella arenaria Valkanov, 1970

This species appears to have a cosmopolitan distribution and is found in salinities varying from 26·1–37·8‰. The shell is colourless, ovoid in outline, sometimes having almost parallel lateral margins which curve evenly in the aboral region but often curve irregularly around the aperture (Fig. 6). In lateral view it is elliptical, tapering rapidly towards the aperture (Fig. 8). The aperture is oval and invaginated (Fig. 9). Most of the shell surface is smooth, and composed of overlapping, flattish particles of quartz held together by organic cement (Fig. 5). It would appear that the apertural surface is made of small flat particles, whilst the curved surface of the remainder of the shell is made from a mixture of small and large, flattish particles. The aperture is surrounded by a thickened, often rough, irregular disc-like extension composed of an assortment of quartz particles (Figs 6, 7 and 10).

In the original description Valkanov (1970) noted that the quartz particles bordering the aperture were larger than those of the shell, whilst Golemansky (1976) described some small specimens, 28–31μm long, with transparent organic shells and particles principally around the aperture. *Centropyxiella elegans* also described by Valkanov (1970) appears to differ in size alone, varying between 70–80μm in length, whereas *C. arenaria* reaches only 60μm.

Specimens of *C. arenaria* collected from the shore at Ostend, North Sea, varied between 35–60μm (Chardez, 1977), whilst those from the Guinea Coast, Atlantic Ocean, were 53–56μm in length (Golemansky, 1976). Measurements of specimens in this study suggest that the length varies between 54–89μm. Individual dimensions of the breadth and the diameter of the aperture are expressed graphically against shell length in Fig. 11. It is possible that both *C. arenaria* and *C. elegans* are present in our sample, but the number of specimens examined are insufficient to reach any conclusions and we have therefore referred to them collectively as *C. arenaria.*

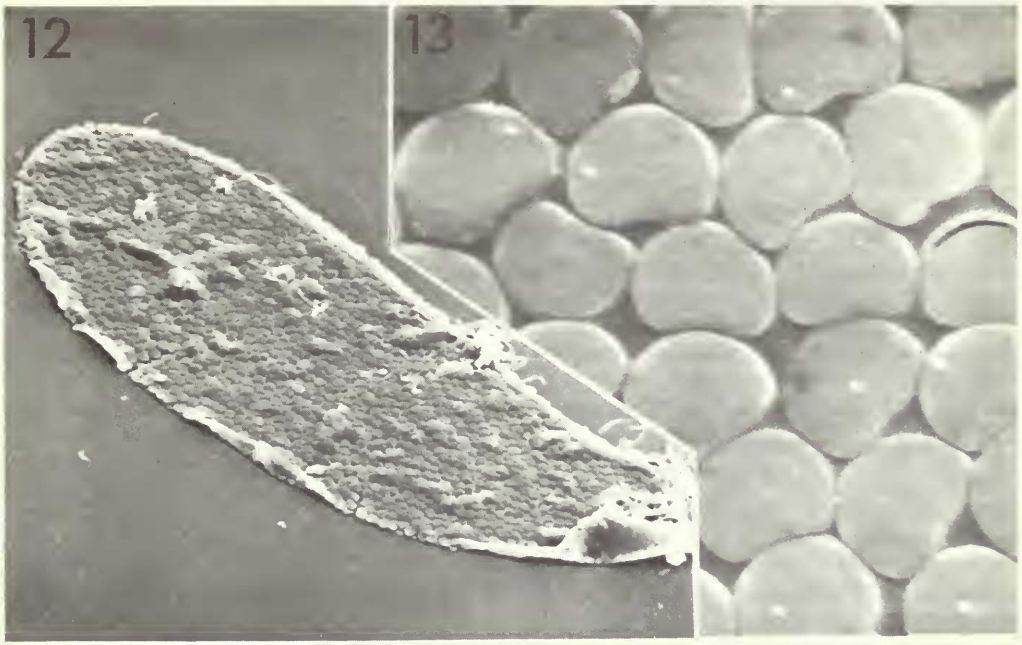


Fig. 12 Collapsed specimen of *Cyphoderia compressa* showing the arrangement of the shell plates × 820.

Fig. 13 Detail of kidney-shaped shell plates of *Cyphoderia compressa* × 9100.

Cyphoderia compressa Golemansky, 1979

This species was described recently from underground water littorals of marine beaches, and is similar to the common freshwater species *C. ampulla* (Ehrenberg, 1840). It is distinguished from *C. ampulla* by the strong lateral compression of the shell. In transverse section *C. compressa* is oval and appears to taper evenly along most of the shell length, whereas in *C. ampulla* the transverse section is circular and has the greatest diameter around the mid-point of the shell and tapers rapidly at both extremities. Unfortunately, as the shells of this species are fragile, they collapsed when air dried in preparation for scanning (Fig. 12).

In species of *Cyphoderia* there appears to be two main arrangements of the siliceous shell plates, these are (i) individually separate plates that lie close together and (ii) those that overlap. These arrangements have been described in detail by Penard (1902), Cash *et al.,* (1915) and more recently by Ogden & Hedley (1980). The shell plates of *C. compressa* (Fig. 13) are similar to those of *C. ampulla,* although the number of kidney-shaped plates – about 1·8μm long and 1·4μm wide – and the amount of visible organic matrix appears to be greater in the former species.

References

Camber, R., Thomas, R. & Le Blanc, M. 1963. Recherches sur la constitution de la thèques des Arcelles (Genre *Arcella,* Rhizopoda testace); observations au microscope électronique. *C. r. Acad. Sci.* **256** : 1364–1366.

Cash, J., Wailes, G. H. & Hopkinson, J. 1915. *The British Freshwater Rhizopoda and Heliozoa.* Vol. 3 *Rhizopoda,* part 3. The Ray Society, London. 156pp.

Chardez, D. 1977. Thécamoebiens du Mésopsammon des Plages de la Mer du Nord. *Revue verviét. Hist nat.* **34** Nos 4 a 6.

Golemansky, V. 1970. Rhizopodes nouveaux du psammon littoral de la mer Noire. *Prostistologica* **6** : 365–371.

—— 1976. Rhizopodes psammobiontes (Protozoa, Rhizopoda) du psammal supralittoral des côtes guinéennes de l'Atlantique. *Acta zool. bulg* **4** : 23–29.

—— 1979. *Cyphoderia compressa* n.sp. (Rhizopoda: Arcellinida) – un nouveau thécamoebien psammbionte du supralittoral des mers. *Acta Protozool.* **18** : (in press).

Hedley, R. H. & Ogden, C. G. 1973. Biology and fine structure of *Euglypha rotunda* (Testacea: Protozoa). *Bull. Br. Mus. nat. Hist. (Zool.)* **25** : 119–137.

Hedley, R. H., Ogden, C. G. & Krafft, J. I. 1974. Observations on clonal cultures of *Euglypha acanthophora* and *Euglypha strigosa* (Testacea: Protozoa). *Bull. Br. Mus. nat. Hist. (Zool.)* **27** : 103–111.

Hedley, R. H., Ogden, C. G. & Mordan, N. J. 1976. Manganese in the shell of *Centropyxis* (Rhizopodea: Protozoa). *Cell. Tiss. Res.* **171** : 543–549.

—— 1977. Biology and fine structure of *Cryptodifflugia oviformis* (Rhizopodea: Protozoa). *Bull. Br. Mus. nat. Hist. (Zool.)* **30** : 311–328.

Mercier, M., Le Blanc, M.. Thomas, R. & Cambar, R. 1964. Observations, en microscopie électronique, sur la constitution de la thèque de quelques Euglyphidae (Rhizopodes, testacés). *C. r. Acad. Sci. (Paris)* **258** : 5967–5968.

Moraczewski, J. 1971. Structure et formation de la coque d'*Arcella. Acta Protozol.* **8** : 423–437.

Netzel, H. 1975. Struktur und Ultrastruktur von *Arcella vulgaris* var. *multinucleata* (Rhizopoda, Testacea). *Arch. Protistenk.* **117** : 219–245.

—— 1976*a*. Die Abscheidung der Gehäusewand bei *Centropyxis discoides* (Rhizopoda, Testacea). *Arch. Protistenk.* **118** : 53–91.

—— 1976*b*. Die Ultrastruktur der Schale von *Difflugia oviformis* (Rhizopoda, Testacea). *Arch. Protistenk.* **118** : 321–339.

Ogden, C. G. 1979. Comparative morphology of some pyriform species of *Difflugia* (Rhizopoda). *Arch. Protistenk.* **122** : 143–153.

Ogden, C. G. & Hedley, R. H. 1980. *An Atlas of Freshwater Testate Amoebae.* British Museum (Natural History) & Oxford University Press, London & Oxford.

Penard, E. 1902. *Faune Rhizopodique du Bassin du Léman.* Geneva. 700pp.

Thomas, R. 1958. Observations sur le revêtement des *Trinema. Bull. Microsc. appl.* **8** : 105–108.

Thomas, R. & Hovasse, R. 1962. Sur la constitution des thèques des Thécamoebiens. I. Le genre *Trinema* et *Trinema lineare* Penard. *Bull. Microsc. appl.* **12** : 117–119.

Valkanov, A. 1970. Beitrag zur Kenntnis der Protozoen des Schwarzen Meeres. *Zool. Anz.* **184** : 241–290.

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